



- (21) Application No. 26161/72 (22) Filed 5 June 1972 (19)
 (31) Convention Application No. P 21 27 685.7
 (32) Filed 4 June 1971 in
 (33) Germany (DT)
 (44) Complete Specification published 18 April 1974
 (51) International Classification F15B 1/04
 (52) Index at acceptance
 FID P18A

(54) ARRANGEMENTS FOR DAMPING PRESSURE OSCILLATIONS

(71) We, DAIMLER-BENZ AKTIEN-GESELLSCHAFT, a Company organised under the laws of Germany, of P.O. Box 202, 7000 Stuttgart 60, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to apparatus for damping pressure oscillations which are transmissible to a column of liquid in a duct and having a damping vessel in which the liquid is separated by a metal diaphragm from an air column.

When liquids flow in pipes it is possible as a result of superimposed pressure fluctuations for generated sound or "hammer" to be introduced and transmitted to other components. These pressure fluctuations which are superimposed on the static pressure can, for example, be brought about by a pump which is designed as a gear pump or rotary pump or can be transmitted to the liquid column by the sound oscillations or vibrations of a unit with a motor to which a pipe or the pump is fixed.

It is known that these superimposed pressure oscillations can be damped by the incorporation of damping vessels in which an air volume is separated from the liquid by a diaphragm.

In the case of a heavily fluctuating static pressure, however, it is only possible for the diaphragm to be correctly designed and adjusted for a given working range.

The invention seeks to provide an improved damping device in which the damping properties of the metal diaphragm can also be adjusted to an optimum in extreme cases.

According to the invention there is provided a damping device for damping pressure oscillations which are transmitted to a column of liquid contained in a duct, wherein said device comprises a damping vessel having a damping chamber connected to said duct and separated from a closed air chamber by a metal diaphragm and the

air chamber is provided with resilient means disposed on the side of said air chamber remote from said metal diaphragm which act in opposition to deflections of the metal diaphragm caused by said pressure oscillations.

In one embodiment of the invention a spring loaded buffer is provided in the damping vessel against which the diaphragm rests when the pressure in the liquid exceeds a pre-determined limit. The buffer can be pressed in the direction of the diaphragm by a spring, the other end of which rests on the part of the damping vessel containing the air column.

In a further feature of the invention the buffer forms part of a piston which is mounted in the damping vessel and is also acted upon by the liquid pressure on the part of the piston remote from the buffer. When this is done, the piston can be pressed by a compression spring against the pressure of the liquid.

The air column which is in an air chamber sealed on one side by the metal diaphragm can be sealed on its other side by a rubber diaphragm with a suitably selected factor of flexibility or stiffness, which is acted upon also by the liquid pressure on the side opposite the column of air.

Embodiments of the invention will be explained in greater detail in the description which follows by way of examples and with reference to the accompanying drawings, in which:—

Figure 1 shows a diagrammatical representation of a longitudinal section through a damping vessel with a buffer and a spring.

Figure 2 is a longitudinal section through a damping vessel with a buffer connected to a piston, which is acted upon by the liquid pressure on its side remote from the buffer.

Figure 3 shows a section through a damping vessel in which an air chamber is sealed on one side by a metal diaphragm and on the other side by a rubber diaphragm.

The device for damping pressure oscillations which can be transmitted to a liquid column located in a pipe shown in Figure 1

[Price 25p]

consists of a damping vessel 1, in which there is fixed a metal diaphragm 2 which defines one side wall of a damping chamber. The damping vessel has a union 3 to which there is connected the liquid column which under certain circumstances is subjected to pressure fluctuations which are transmitted to the damping chamber. On the other side of the diaphragm 2 is a sealed air chamber 7 in which there is arranged a buffer 4, against which the metal diaphragm can rest when the pressure in the column of liquid rises above a predetermined level. As shown in Figure 1, the buffer or stop 4 is designed with contact contours which can be adapted to particular requirements. When the static pressure rises sufficiently, the diaphragm 2 rests on the contact surface of the buffer 4 located on the air chamber side and in this way becomes pressure-resistant. The buffer itself is supported resiliently against the housing by one end of a spring 5 the other end of which rests on the bottom 6 of the part of the damping vessel 1 which contains a volume of air. The spring 5 is selected so that it will provide the requisite adjustment of frequency.

As shown in Figure 2, the buffer 8 can also form one end of a piston 9 which is slidably mounted in the damping vessel 11.

The column of liquid 12 in the damping chamber acts on the diaphragm 2 and the buffer 8, the piston 9 extending into the connection 18 through the air chamber 17 on the side of the diaphragm 2 remote from the liquid 12.

The piston 9 is mounted in two bores 13 and 14 in the damping vessel 11 so that it can move along its longitudinal axis. These bores 13 and 14 are located in two partitions 15 and 16, the partition 16 sealing the air chamber 17 in relation to the liquid column 12, which acts through the union 18 into of the piston 9. In order to increase the volume of air, the partition 15 can be provided with apertures. A disc 21 is mounted on the piston 9, which is secured against longitudinal movement and on which rests one end of a spring 22, the other end 23 of which rests against the partition 15. Accordingly the spring 22 presses the piston 9 against the pressure in the liquid column acting through the union 18.

As a result of the static pressure acting on both sides of the cylinder as shown in Figure 2, the diaphragm 2 is supported from the rear. Here again the contour of the buffer 8 can be designed differently according to conditions. By suitably adjusting the

spring 2 it is possible for the pressure oscillations to be kept away from the rear of the diaphragm or else by suitable phase rotation it is possible for the action of the diaphragm to be increased still further.

Figure 3 shows a damping device 24 in which the air column 25 is sealed at one end by the metal diaphragm 2 and at the other end by a rubber diaphragm 26 with a suitably chosen spacing constant or rate. Like the metal diaphragm 2, this rubber diaphragm is acted upon on its side which is remote from the air column by the pressure of the liquid column 27, which is connected to the unions 28 and 29. The stiffness of the rubber diaphragm 26 must be designed in such a way that the requisite differential pressure between the liquid column 27 and the air column 25 is obtained.

WHAT WE CLAIM IS:—

1. A damping device for damping pressure oscillations which are transmitted to a column of liquid contained in a duct, wherein said device comprises a damping vessel having a damping chamber connected to said duct and separated from a closed air chamber by a metal diaphragm and the air chamber is provided with resilient means disposed on the side of said air chamber remote from said metal diaphragm which act in opposition to deflections of the metal diaphragm caused by said pressure oscillations.
2. Device according to claim 1 wherein the resilient means comprises a resilient buffer arranged in the damping vessel and against which the metal diaphragm is supported when the pressure in the liquid column exceeds a predetermined level.
3. Device according to claim 2, wherein the buffer is pressed in the direction of the metal diaphragm by one end of a spring, the other end of which rests on a part of the damping vessel containing the air column.
4. Device according to claim 2 or claim 3, wherein the buffer forms one end of a piston which is mounted in the damping vessel and is acted upon by the liquid pressure on its other end which is remote from the buffer.
5. Device according to claim 4, wherein the piston is pressed by a compression spring against the liquid pressure acting on said other end.
6. Device according to claim 1, wherein the air chamber is sealed on one side by said metal diaphragm and is sealed on its other side by a rubber diaphragm having a predetermined spring rate or constant which is also acted upon by the liquid pressure on

its side remote from the air chamber.

7. A device for damping pressure oscillations substantially as hereinbefore described with reference to Figure 1 or Figure 2 or Figure 3 of the accompanying drawings.

JENSEN & SON,
Agents for the Applicants,
8, Fulwood Place,
High Holborn,
London, WC1V 6HG.
Chartered Patent Agents.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1974.
Published at The Patent Office, 25 Southampton Buildings, London WC2A 1AY,
from which copies may be obtained.

